SEDAR 10 Review Workshop Report

South Atlantic Gag Grouper

Prepared by the SEDAR 10 Review Panel
June 26 - 30, 2006
Atlanta GA

Executive Summary

The SEDAR 10 Review Workshop took place in Atlanta, Georgia, June 26-30, 2006 and reviewed two stock assessments; South Atlantic gag grouper and Gulf of Mexico gag grouper. On Monday, June 26, the Review Workshop Panel received a presentation from the South Atlantic gag grouper assessment team, and on Tuesday, June 27, a similar presentation from the Gulf of Mexico gag grouper assessment team. The balance of the week, through Thursday afternoon, was devoted to additional discussion with the assessment teams to refine and better understand the assessments. Draft versions of the two advisory reports were discussed on Thursday. All parts of the meeting, with the exception of Friday morning, were open to the public. On Friday, the Panel discussed initial drafts of the Consensus Summary documents.

The Review Panel commends the two assessment teams and was especially impressed by the responsiveness of both teams to requests for additional analyses and clarifying information. The Review Panel was also very appreciative of the helpful feedback and suggestions from all SEDAR 10 attendees as we discussed initial drafts of Review Workshop documents.

The Review Panel also appreciates the organization of SEDAR 10 in that two gag grouper stocks were assessed via a common Data Workshop and concurrent and complementary Assessment Workshops. This allowed the Review Panel to not only better understand the individual stock assessments but to offer more consistent advice to the two managing Councils.

From that point of view the Review Panel notes that the development of the stocks has been similar, presumably because the fisheries have followed similar paths.

In both stock areas, recruitment has increased in recent years, although the increase is more pronounced in the Gulf of Mexico than in the South Atlantic. Recruitment is estimated to have been about 5 times higher, on average, in the Gulf of Mexico than in the Atlantic.

For both stocks, relative SSB's were high in the early 1960s, declined more or less regularly until the early 1990s when both started to increase. The 2004 SSB in the Gulf of Mexico is almost 60% above average, close to the maximum observed in the early 1960s, while for the South Atlantic, the 2004 SSB is 20% above average.

Estimated fishing mortality increased at a very similar rate from the early 1960s to the early 1980s. Since then, both have fluctuated without a clear trend around an average of 0.48 in the South Atlantic and about 0.30 in the Gulf of Mexico.

An important result of the Review Workshop is determination of current stock status relative to biological reference points established in the respective FMPs.

In both stock areas, the stock and recruitment scatter plot do not suggest that recruitment is strongly linked with SSB. In the South Atlantic, the Beverton-Holt stock-recruitment relationship indicates little change in recruitment for a wide range of SSB's and that B_{MSY} falls in the range of SSB's observed in the past. On the other hand, the Ricker stock-recruitment relationship indicates that maximum recruitment occurs at SSB's lower than those observed over the period of the assessment, which implies that B_{MSY} would also be lower than those observed in the period of the assessment. In the Gulf of Mexico, both the Beverton-Holt and Ricker relationships suggest that considerably higher recruitment would result from larger SSB's and B_{MSY} is estimated to be higher than SSB's observed in the past. The Review Panel considers that the stock recruitment relationships in the two stock areas are equally uncertain. The derived benchmarks are considered useful for management in the South Atlantic, because they are within the range of past observed values. In the Gulf of Mexico, more stock and recruitment observations are necessary to confirm that the benchmarks estimated in the current assessment are indeed attainable.

The Minimum Stock Size Threshold (MSST), currently defined by the South Atlantic Council as $(1\text{-}M)*B_{MSY}$, is very close to B_{MSY} because age-averaged natural mortality rate, M, is estimated as 0.14. Given the uncertainties in the assessment, the biomass would be expected to fall below MSST with a relatively high frequency even if, in fact, the true biomass was close to B_{MSY}. In addition, MSST, as currently defined, may be overly conservative. There are no indications of impaired recruitment at the lowest observed SSB (around 5 million lbs) and the Review Panel suggests that MSST could be set at this level as an operational definition to be re-examined at the next assessment.

Current rates of exploitation indicate that overfishing is occurring for the South Atlantic gag grouper stock. Relative to the current value of the MSST specified by the FMP, South Atlantic gag is approaching an overfished condition and is projected to become overfished in 2007 (see Advisory Report projections). Relative to the MSST proposed by the Review Panel, the stock is not overfished and is not projected to become overfished under any of suggested constant fishing mortality mid-term projection scenarios (also discussed and displayed in the Advisory Report).

Post-Review Workshop Note:
An error was identified in the Atlantic gag input values for the recreational (MRFSS) harvest. The error was corrected and updated model results provided in February 2007. However, comments in this report are based on those results available to the review panel and may differ slightly in some instances from the results of the updated model. Values in the advisory report were updated to reflect the corrected model, and notes are added to this consensus report to indicate any values which differ as a result of the error correction.

1. Introduction

1.1. Workshop Time and Place

The SEDAR 10 Review Workshop met at the Doubletree Atlanta Buckhead in Atlanta, Georgia from June 26 - 30, 2006.

1.2. Terms of Reference

1. Evaluate the adequacy, appropriateness, and application of data used in the assessment.
2. Evaluate the adequacy, appropriateness, and application of methods used to assess the stock.
3. Recommend appropriate estimates of stock abundance, biomass, and exploitation.
4. Evaluate the methods used to estimate population benchmarks and management parameters (e.g., MSY, Fmsy, Bmsy, MSST, MFMT, or their proxies); provide values for management benchmarks, range of ABC, and declarations of stock status.
5. Evaluate the adequacy, appropriateness, and application of the methods used to project future population status; recommend appropriate estimates of future stock condition.
6. Ensure that stock assessment results are clearly and accurately presented in the Stock Assessment Report and that reported results are consistent with Review Panel recommendations.
7. Evaluate the performance of the Data and Assessment Workshops with regard to their respective Terms of Reference; state whether or not the Terms of Reference for those previous workshops were met and are adequately addressed in the Stock Assessment Report.
8. Review research recommendations provided by the Data and Assessment workshops and make any additional recommendations warranted.
9. Prepare a Peer Review Consensus Summary summarizing the Panel's evaluation of the stock assessment and addressing each Term of Reference. Prepare an Advisory Report summarizing key assessment results. (Reports to be drafted by the Panel during the review workshop with a final report due two weeks after the workshop ends.)

1.3. List of Participants

Review Panel

Terry Smith, Chair .....NOAA Fisheries/Sea Grant
Din Chen ..... CIE
Jean-Jacques Maguire ..... CIE
John Wheeler ..... CIE

Presenters

Mauricio Ortiz.....SEFSC
Clay Porch.....SEFSC

Steve Turner.....SEFSC
Doug Vaughan.....SEFSC
Erik Williams.....SEFSC

Appointed Observers

Brian Cheuvront.....SAFMC SSC
Phil Conklin.....SAFMC AP
Marianne Cufone ..... GMFMC NGO Representative
George Geiger .....SAFMC
Will Patterson.....GMFMC SSC
Roy Williams .....GMFMC
Bob Zales II.....GMFMC AP

Observers

Roy Crabtree ..... SERO
Elizabeth Fetherstone..... Ocean Conservancy
Dennis O'Hern.....GMFMC AP
Andy Strelchek..... SERO

Staff

Steven Atran.....GMFMC
John Carmichael..... SEDAR
Tyree Davis.....SEFSC
Rick DeVictor.....SAFMC

1.4. List of Review Workshop Working Papers & Documents

The Review Panel was provided all SEDAR Working Papers and associated research documents considered at the SEDAR 10 Data and Assessment Workshops. Additional resources provided for the Review Workshop are listed below.

SEDAR Working Papers		
SEDAR10-RW01	Virtual population analysis of the Gulf of Mexico gag grouper stock: the continuity case.	Sladek-Nowlis, J.
SEDAR10-RW02	Status review of gag grouper in the US Gulf of Mexico, SEDAR 10.	Ortiz, M
SEDAR DRAFT ASSESSMENT REPORTS		
SEDAR10-SAR1 *Review Draft*	South Atlantic Gag Grouper SEDAR Assessment Report	
SEDASR10-SAR2 *Review Draft*	Gulf of Mexico Gag Grouper SEDAR Assessment Report	

2. Consensus Summary

2.1. Background and summary

- **Documents provided and reviewed**: The Review Workshop (RW) is the third meeting in the SEDAR 10 process. The Panel was provided reports (*S10SAR1-SAgag Sect12.pdf* and *S10SAR1Sect3AtlGagAW.pdf*) from both Data Workshop (DW) and Assessment Workshop (AW) before the Review Workshop. The panel reviewed these documents and the series of working documents cited in those reports.

- **Assessment Scientists:** The Atlantic gag grouper assessment was presented by Drs. Erik Williams and Doug Vaughan on Monday, June 26th.

- **Assessment Data**: The Assessment was based on the data from the Data Workshop, which are summarized in *S10SAR1-SAgag Sect12.pdf*. Data sources include abundance indices, recorded landings (commercial handline and diving, recreational headboat and recreational landings derived from the Marine Recreational Fishing Statistics Survey, MRFSS), and samples of annual size compositions and age compositions. Three fishery–dependent abundance indices were developed by the SEDAR-10 DW: one from the NMFS headboat survey, one from the commercial logbook program, and one from the MRFSS survey. There are no usable fishery–independent abundance data for this stock at this time. Landings data were available from all recreational and commercial fisheries.

- **AW Assessment Model and base runs:** The South Atlantic gag grouper stock was assessed with two models: a statistical catch-at-age model as the primary assessment model and an age-aggregated production model to investigate results under a different set of model assumptions. Within each type of model various configurations and sensitivity runs were explored. The AW developed two base runs: one assuming a time-varying catchability and one assuming constant catchability for the fishery dependent indices. Each base run of the catch-at-age model was the basis for estimation of benchmarks and stock status. Assumptions and results are summarized in *S10SAR1Sect3AtlGagAW.pdf.*

- **RW Preferred based model**: The Review Panel evaluated the assessment and identified a number of concerns, which led to requests for clarifications and several sensitivity runs. As a result, the Panel recommended the base run with constant catchability as the preferred “base model”.

2.2. Review Workshop Terms of Reference

1. Evaluate the adequacy, appropriateness, and application of data used in the assessment.

- **Assessment Data Adequacy, Appropriateness**: The data for this species were finalized from the SEDAR Data Workshop and reported in *S10SAR1-SAgag Sect12.pdf*. Overall, the data were deemed appropriate and used in an appropriate manner subject to the concerns of lacking systematic age and length sampling, no fishery independent indices, and highly variable annual MFRSS estimates.

- **MFRSS**: The RW was concerned about the MFRSS series because of highly variable annual estimates and the lack of age/length composition. Lack of length samples from MRFSS resulted in use of headboat length compositions to reflect MRFSS landings. Because charter boat landings dominated MRFSS, the RW agreed that this was a reasonable assumption although headboat length compositions may differ from those observed in the private boat mode.

  MRFSS PSE (proportion standard error) was highly variable with generally higher values in the earlier years (1980s). More importantly, the sensitivity runs by the AW which examined model output by increasing and decreasing MRFSS catch by 50% (especially the decreasing run), substantively changed the view of the status of the stock. In addition, removing a portion of the MRFSS catch can make the stock appear to be less productive. However, given the lack of evidence of a consistent and persistent bias in the MRFSS data, the RW panel concluded that the MFRSS was variable, but not biased, and the decision was made to use the original data.

  MRFSS landings are the largest contributor to total landings but are poorly sampled. The MRFSS landings are dominated by charter boat landings, presumably from fishing similar to that on headboats. It was noted that the MRFSS index is based on catch (A+B1+B2) while headboat and commercial handline indices are based only on landings.

- **Model fits to sex ratio data:** A detailed description of the life history data and initial probit analysis on sex ratio and maturity of South Atlantic gag was presented in a report prior to the Data Workshop (SEDAR10-DW-15). Following the Data Workshop, final parameter fits were developed and summarized in Table 2.1 (p. II-33) of the Data Workshop Report (Section II). Discussion by the panel was concerned with the data available for the probit analysis on sex transition (proportion females) at age. Initially a request was made to compare the observed proportions female at age with model predicted female at age for each time period. Because these data was not readily available, the sample sizes available for each time period were provided:

Early period (1977-82): 322 fish
- Middle period (1994-95): 1508 fish
- Late period (2004-05): 1048 fish

These sample sizes were deemed adequate for representing sex ratio. Linear interpolation of the model predicted proportion female-at-age was applied to years between these periods.

- **Catchability**: The RW discussed the relationship of technology to catchability and the effects of catchability changes on fishery-dependent abundance indices. The RW recognized that technology improvements over time, particularly better electronics, have made fishermen more effective and efficient at catching fish, but disagreed with the assumption of a simple linear (2% annually) constant increase. This issue is important for the present stock assessment because the assessments rely heavily on fishery-dependent catch rate abundance (CPUE) indices.

  When a unit of effort becomes more efficient at catching fish, the resulting abundance index becomes biased, making fish appear relatively more abundant. In contrast, fishery-independent indices based on standardized methods to control fishing efficiency over time are not subject to this problem. No fishery-independent indices were available for the South Atlantic gag assessment.

- **Indices:** Correlation among the three fishery dependent indices was discussed. It was noted that there was a marginally significant negative correlation between the headboat and commercial handline indices. In the most recent few years, commercial handline CPUE has been increasing while the headboat index has been declining.

- **Stock structure**: South Atlantic gag grouper and Gulf of Mexico gag grouper were assessed as two separate stocks. The RW discussed stock movement and mixing. It was reported that there were several mark-recapture experiments carried out on fish movement between these two regions. However, there was no consensus and quantitative analysis for these mark-recapture experiments. The RW believes that input data and assessment approaches are similar and there is common ground for these two assessments.

  Differences between life history (e.g., sex ratio, maturity, etc.) for the Gulf and South Atlantic stocks were noted and habitat differences were suggested as possibly contributing to the differences.

  Nevertheless, the biological parameters (growth, maturity, natural mortality, gender changes) for the two stock areas appear sufficiently similar to imply that it could be worthwhile to re-estimate the parameters using pooled data.

In the South Atlantic, the age range tabulated in the analyses extend to age 20 while in the Gulf of Mexico (GOM) it extends to age 12.

- **Natural mortality rate**: The DW and AW recommended age-based natural mortality (averaged M=0.14) using the Lorenzen (1996) approach. The RW discussed this rate and recommended that the DW and AW analyze the existing mark-recapture data with some appropriate mark-recapture models, such as a Brownie model, to estimate the natural mortality.

- **Length-weight bias**: The RW discussed the bias correction used for weight-length regressions and confirmed that there was no transformation of the data prior to running the regression. It was noted that the correction assumes that the regression parameters are known (based on lognormal distributional properties). However, these parameters are estimated and not known. The proper statistical correction can be found in Chen (2004). Here, given the small value of MSE (~0.047), the difference is generally small (but would be larger for extreme values of lengths away from mean length). A more detailed discussion of this topic can be found in the research recommendations.

2. Evaluate the adequacy, appropriateness, and application of methods used to assess the stock.

- **Methods:** The assessment methods are considered to be appropriate for the available data. The methods used for standardization of the catch and effort data are appropriate. The RW Panel was impressed with the presentation and the number of sensitivity analyses.

- **Models**: For the available data, two models were used as the assessment methods for this stock. A statistical catch-at-age model was used as the primary assessment model and an age-aggregated production model was used to investigate results under a different set of model assumptions. Within each type of model various configurations and sensitivity runs were explored for the catchability coefficient.

- **Residuals**: The RW was concerned about patterns in the recruitment residuals which might indicate that the stock-recruitment model did not fit the data properly. The RW requested further investigation, including graphs, showing the year of the stock-recruit data observation. Results indicated that temporal autocorrelation was not statistically significant.

- **Spawner-recruit models**: The management benchmarks are based on the estimated stock-recruitment model. The RW had extensive discussion on this topic and requested analysis of autocorrelation in the recruitment time series (as reported above). The RW also requested that the stock-recruit relationship

be re-estimated with an additional autocorrelation parameter. The autocorrelation function fit suggests there is no significant autocorrelation at lag 1 or higher (Figs 8 and 9 in the Addendum to Stock Assessment Report).

The S/R plot with year information suggested a negative slope to the S/R relationship (Fig 6 in the Addendum). The RW suggested incorporating environmental information into the SR analysis and recommended further investigation of the relationship in future assessments.

In the assessment, the parameters of the Beverton-Holt (BH) spawner-recruit model were estimated within the assessment model (based on years 1972-2004) with lognormal deviations (a loose constraint was put on these deviations). Concern was raised that no model fits were made for an alternate model such as a Ricker spawner-recruitment relationship. During the meeting the RW was provided results from a Ricker SR model and found that the Ricker model provided a statistically better fit to the SR data than the BH model. The RW discussed the fact that the fitted Ricker relationship, if correct, implies the existence of some mechanism which leads to lower recruitment at higher SSB. Mechanisms were proposed and discussed but the issue could not be resolved given available data and life history information. The RW noted that the stock–recruitment relationship is crucial in determining the validity and value of status determination reference points and suggested that the stock-recruitment relationship for the two stocks reviewed in SEDAR 10 be comprehensively re-examined prior to the next formal assessment of gag grouper.

- **CPUE Index Weighting**: The RW discussed the weightings on indices, suggesting that increased weighting on MRFSS would lead to poorer fits.

- **Sensitivity investigations**: To better understand the behavior of the assessment model for the input data series, the RW panel requested sensitivity model runs for the preferred base model (i.e., constant catchability). The base model run contains three fishery dependent CPUE indices and three sets of age and length composition datasets (commercial handline, commercial diving, and recreational headboat fisheries). Nine additional model runs removing each index, each fishery age composition dataset, and each fishery length composition dataset, one at a time, were provided. Results suggest that the base model provides a balanced fit to all the data sources, illustrated by the base run falling within the middle of this set of sensitivity runs (Figures 12-14 in the Advisory Report). Relative to SSB, the run with the headboat CPUE data omitted shows the population increasing rapidly in the most recent years, reaching the highest terminal value of all the runs. In contrast, the run with the commercial handline CPUE omitted results in the lowest SSB value in the terminal year (Figure 12 in the Advisory report). This highlights the balanced fit between these two indices, which show opposite trends in the last few

years.. The RW Panel recommends that a way of displaying the influence of each data source on the final assessment results be found and shown in the next assessment.

3. Recommend appropriate estimates of stock abundance, biomass, and exploitation.

- The details and rationale for the appropriate estimate of stock abundance, biomass and exploitation are listed in the Advisory report and the Addendum to the Assessment Report.

4. Evaluate the methods used to estimate population benchmarks and management parameters (e.g., MSY, Fmsy, Bmsy, MSST, MFMT, or their proxies); provide values for management benchmarks, range of ABC, and declarations of stock status.

- The methods to estimate population benchmarks and management parameters are based on the B-H stock-recruitment model estimated externally from the catch at age model with the RW preferred "base model". The estimates of these benchmarks are listed in the Advisory report and summarized as follows:

  MFMT, the Maximum Fishing Mortality Threshold, is set to F_{MSY} Proxy = $F_{30\%SPR}$.
  MSST, the Minimum Stock Size Threshold, is set to (1-M)B_{msy}.

- Status Determination Criteria: The SFA and management criteria recommendations and values are estimated from the preferred base model by the RW and summarized in the advisory report.

Declarations of Stock Status:

- Stock Status: Current rates of exploitation indicate that overfishing is occurring for the South Atlantic gag grouper stock. Relative to the current value of the MSST specified by the FMP, South Atlantic gag is approaching an overfished condition and is projected to become overfished in 2007. Relative to the MSST proposed by the RW, the stock is not overfished and is not projected to become overfished under any of the projection scenarios (see Figure 6, South Atlantic Gag Grouper Advisory Report).

- The current definition of MSST may be overly conservative. The RW recommended an operational definition of MSST of 5 million pounds (see Advisory Report). (*Post-Workshop NOTE: The 5 million pounds cited here is based on the original results provided the panel. After correction of an error in the recreational (MRFSS) landings tabulation of the assessment input file, the comparable MSST based on the arguments made by the review panel is 4 million pounds.)*

- SEDAR and management agencies should be aware that all reference points are considered to be imprecisely estimated.

5. Evaluate the adequacy, appropriateness, and application of the methods used to project future population status; recommend appropriate estimates of future stock condition.

- Projection of this stock is based on the RW-recommended "base model

- Estimates of recruitment in 2002-2004 are below average and fishing mortality rates in 2002-2004 are above the MSY level. Nevertheless, the stock projections suggest that the stock will remain above the proposed MSST in the medium-term. Projections with various constant fishing mortality rates starting in 2008 are shown in Table 3 and Figures 6-10 in the Advisory report.

- These projection methods are not adequate for forecasting the effects of management measures that involve changing selection patterns, such as changes to minimum landing sizes and bag limits. The methods are, however, adequate for exploring the information content and management implications of small and incomplete data sets such as that available for gag grouper.

6. Ensure that stock assessment results are clearly and accurately presented in the Stock Assessment Report and that reported results are consistent with Review Panel recommendations.

- The panel recommended a preferred "base model" for this stock based on an assumption of constant catchability. Alternative configurations l are listed in the Stock Assessment Report and the Addendum to the Assessment Report.

7. *Evaluate the performance of the Data and Assessment Workshops with regard to their respective Terms of Reference; state whether or not the Terms of Reference for those previous workshops* were met and are adequately addressed in the Stock Assessment Report.

- The RW evaluated the terms of reference from both DW and AW with consensus that the TOR were met.

8. Review research recommendations provided by the Data and Assessment workshops and make any additional recommendations warranted.

Additional Recommendations

- **Time-varying catchability**: The RW is of the opinion that catchability has changed over time, however, it does not believe that a constant 2% increase per year adequately describes the changes in catchability that are likely to

have occurred. Step changes with the introduction of new equipment or management measures are more likely than monotonic changes. Learning and technological changes in navigation, fish detection and catching equipment have no doubt increased the efficiency of nominal fishing effort. However, management measures (increases in minimum size, time and area closures, bag limits) and changes in fishing behavior (moving on when "enough" fish have been caught) would be expected to result in decreased catchability. The Panel believes that, overall, catchability is likely to have increased. The Panel recommends that a special workshop be convened to estimate and quantify changes in catchability over the last 25 to 30 years.

- Strengthen the **MRFSS** program to provide more precise estimations of the age/length composition.

- Provide more detailed model diagnostics, such as complete lists of estimated parameters together with their estimated standard errors, in model sensitivity runs.

- Enforce the model residuals diagnostics to test for time series autocorrelation contributions to the lack of goodness of fit in the assessment.

- **Mark-recapture experiments**: Analyze the existing mark-recapture data and initiate new mark-recapture studies, which will help identify movements and migrations between two stocks, estimate fishing mortality, enhance population estimates; and better identify the stock structure and habitat preferences.

  The RW recommends analysis of the existing tagging data for movement within/between the two stocks., Quinn and Deriso (1999) comprehensively reviewed different forms of movement models, including: the diffusion model (Hilborn 1987; Deriso et al. 1991; Fournier et al. 1998), the generalized movement estimation (Ishii 1979, Sibert 1984, Anganuzzi et al. 1994; Xiao 1996, Xiao et al. 1999,; Xiao and McShane 2000), and the movement-estimation mark–recapture methods (Seber 1982, Brownie et al. 1985, Schwarz et al. 1993). The Brownie model may be an excellent approach to alternate estimates of natural mortality rate.

  The RW recommends new tagging experiments, in order to estimate mixing rates and the associated fishing mortality independent of the commercial fishing. It is essential to analyze the existing tagging database to ascertain what can be done with the existing data in order to develop a new design for the future tagging experiment. This would include an effective design for tagging mortality, tagging shedding, reporting rates to get a higher confidence level in stock assessment, migration patterns, and growth.

- **Bias on estimating weight from the log-log length-weight relationship**

The two stocks reviewed in SEDAR 10 used a log-log length-weight relationship to estimate weights from a back-transformation. The RW discussed a potential bias associated with this back-transformation illustrated as follows:

Usually, the length-weight relationship is assumed to be $wt = aL^b$ with a log-normal error. A log-transformation is commonly used to linearize the equation and cast the estimation problem into the simple linear regression as:

$$y = \ln(wt) = \ln(a) + b\ln(L) + \varepsilon = \alpha + \beta\ln(L) + \varepsilon \qquad (1)$$

The parameters from this simple linear regression can be estimated by least squares. With estimated parameters: $\hat{\alpha}, \hat{\beta}$, the predicted weight ($w_0$) from a specific length (L_0) is then back-calculated:

$$\hat{w}_0 = e^{\hat{\alpha}+\hat{\beta}\ln(L_0)} \qquad (2)$$

Or with a bias corrected equations as in both assessments as

$$\hat{w}_0 = e^{\hat{\alpha}+MSE/2+\hat{\beta}\ln(L_0)} \qquad (3)$$

We would want an unbiased predicted weight of w. It can be shown that both back-calculations in (2) and (3) are biased high as an estimate to the weight of $wt = e^{\alpha+\beta\ln(L)} = aL^b$ with (3) used in the Assessment bias-higher than (2) since

$$E(\hat{w}) = E\left(e^{\hat{\alpha}+\hat{\beta}\ln(L)+\varepsilon}\right) = e^{E\left(\hat{\alpha}+\hat{\beta}\ln(L)+\varepsilon\right)+\frac{V\left(\hat{\alpha}+\hat{\beta}\ln(L)+\varepsilon\right)}{2}} = e^{\alpha+\beta\ln(L)}e^{\frac{V\left(\hat{\alpha}+\hat{\beta}\ln(L)+\varepsilon\right)}{2}} = w\times e^{\frac{V\left(\hat{\alpha}+\hat{\beta}\ln(L)+\varepsilon\right)}{2}}$$

The predicted weight from the estimated log-log length-weight model is biased-high with the bias: $e^{\frac{V\left(\hat{\alpha}+\hat{\beta}\ln(L)+\varepsilon\right)}{2}} = e^{\frac{\sigma^2+V\left(\hat{\alpha}+\hat{\beta}\ln(L)\right)}{2}}$.

Therefore this bias is not only dependent on the estimated model variance $\hat{\sigma}^2$=MSE, but is also dependent on the estimated correlation between the parameters. In addition, the bias is dependent on the specified length (len_0) to be predicted with the smallest bias at len_0 = (mean observed length). This means that the prediction bias is not constant over the data range (contrary to the common bias correction $wt_0 = e^{\hat{\alpha}+\hat{\beta}\times len_0-\hat{\sigma}^2/2}$). In the case of extrapolation to large lengths, this bias could be remarkably significant. Details can be found in Chen (2004).

9. Prepare a Peer Review Consensus Summary summarizing the Panel's evaluation of the stock assessment and addressing each Term of Reference. Prepare an Advisory Report summarizing key assessment results. (Reports to be drafted by the Panel during the review workshop with a final report due two weeks after the workshop ends.)

First drafts of the Consensus Summary and Advisory Report were completed during the Review Workshop. All Review Panel members contributed to the Consensus Report. The assessment team completed the first draft of the Advisory Report which was then reviewed by the Review Panel. The Consensus Report and Advisory Report were completed by email subsequent to the Review Workshop.

2.3. General recommendations to SEDAR

- There was large volume of documentation associated with this RW. The Review Panel recommends a clear executive summary for all substantive Data and Assessment Documents.

- It could be more informative to distribute a succinct table of model equations and parameters (estimated and observed) to be provided for each assessment along with, if appropriate, a table of management options (e.g. a decision table) and the risks associated with them.

2.4 Special Comments

In both stock areas, the stock and recruitment scatter plot do not suggest that recruitment is strongly linked with SSB. In the South Atlantic, the Beverton-Holt stock-recruitment relationship indicates little change in recruitment for a wide range of SSB's and that B_{MSY} falls in the range of SSB's observed in the past. The Ricker stock-recruitment relationship indicates that maximum recruitment occurs at SSB's lower than those observed over the period of the assessment, which implies that B_{MSY} would also be lower than those observed in the period of the assessment. In the Gulf of Mexico, both the Beverton and Holt and Ricker relationships suggest that considerably higher recruitment would result from larger SSB's and B_{MSY} is estimated to be higher than SSB's observed in the past. The RW considers that the stock recruitment relationships in the two stock areas are equally uncertain. The derived benchmarks are considered useful for management in the South Atlantic, because they are within the range of past observed values. In the Gulf of Mexico, more stock and recruitment observations are necessary to confirm that the benchmarks estimated in the current assessment are indeed attainable.

MSST, currently defined in the FMP as (1-M)*BMSY, will be very close to B_{MSY} because M = 0.14 is used. Given the uncertainties in the assessment, the biomass would be expected to be estimated to fall below MSST with a relatively high frequency even if the true biomass were close to B_{MSY}. In addition, MSST, as currently defined, may be overly conservative for the South Atlantic. There are no

indications of impaired recruitment at the lowest observed SSB (around 5 million lbs) and the MSST could be set at 5 million lbs as an operational definition to be re-examined at the next assessment.

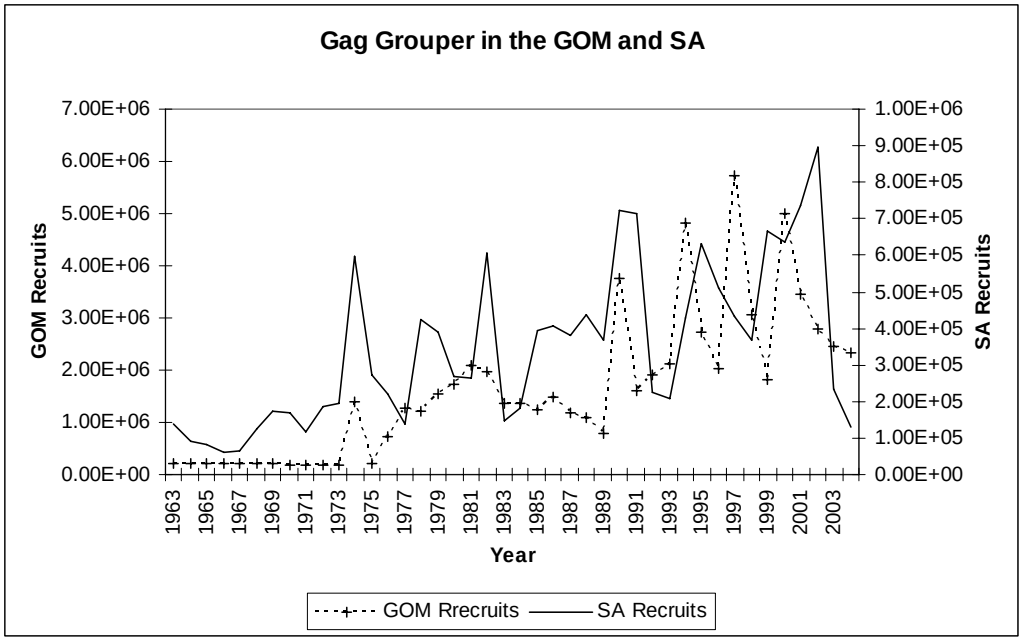
Comparing and Contrasting the Two Gag Grouper Assessments

(Note that comparisons presented here are based on Atlantic gag assessment results available to the review panel. Final results after correction of an input data error are different. See the Assessment Workshop report for details.)

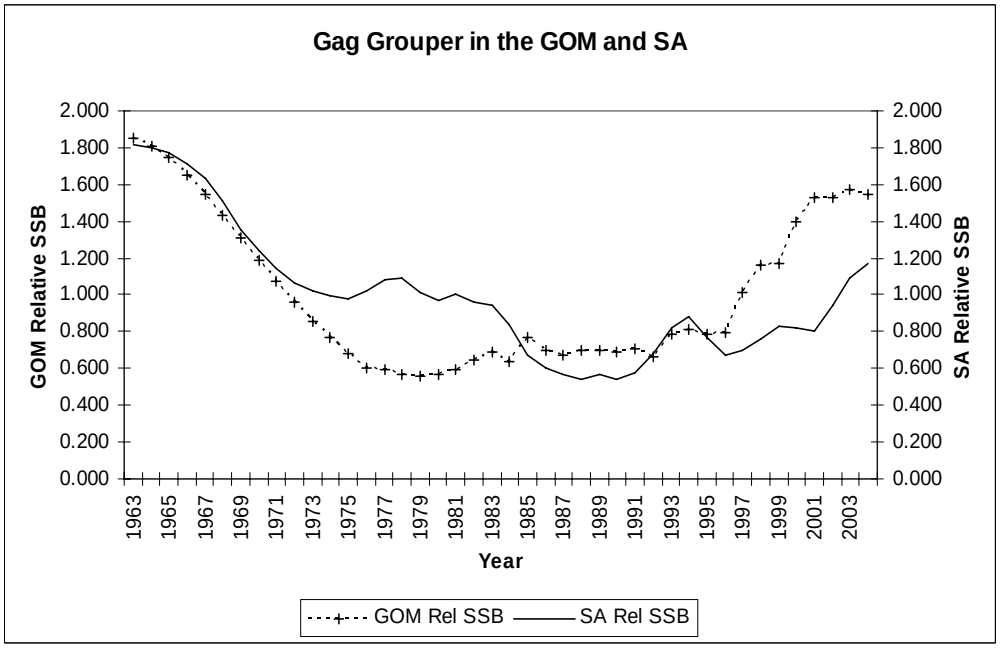
The main assessment model for both stock areas is a statistical catch at age model, but the implementations differ. For the South Atlantic a customized model has been developed using ADMB while for the Gulf of Mexico, an existing piece of software (CASAL (C++ algorithmic stock assessment laboratory which can be downloaded from ftp://ftp.niwa.co.nz/software/casal) was used. CASAL was one of several integrated assessment software programs recently evaluated by the IATTC; the report can be downloaded at http://www.iattc.org/PDFFiles2/Assessment-methods-WS-Nov05-ReportENG.pdf. For the South Atlantic, a production model (ASPIC) was also run and for the Gulf of Mexico two VPA's were run: one was a strict continuity run and the other one was parameterized to mimic the CASAL run. VPA was not used in the South Atlantic because of insufficient complete catch at age information. The RW Panel considers that the statistical catch at age approach has better statistical foundations and more flexibility in the type of information that can be used than VPA or general production models. The RW Panel recommends that alternate assessment approaches (ASPIC for the South Atlantic and VPA for the Gulf of Mexico) continue to be used in parallel and that the results be presented in the report of the Assessment Workshops. Standard inputs (catch at age, length at age, weights at age, indices of stock size, by age and length if appropriate) and outputs (population numbers at age, population biomass at age, spawning biomass, fishing mortality at age) should be provided in a format easily readable by spreadsheet programs. Neither of the assessments considers gender explicitly.

Although the approach has been used in the assessment of other species, it is not clear that the ADMB statistical catch at age implementation conforms to the Model Acceptance Note 1 in the ToRs of the AW. The assessment team is encouraged to provide the required documentation and work towards including the assessment in the NFT packages. Presumably, the evaluation performed by the IATTC implies that the CASAL does conform to the Model Acceptance Note 1 in the provided Terms of Reference.

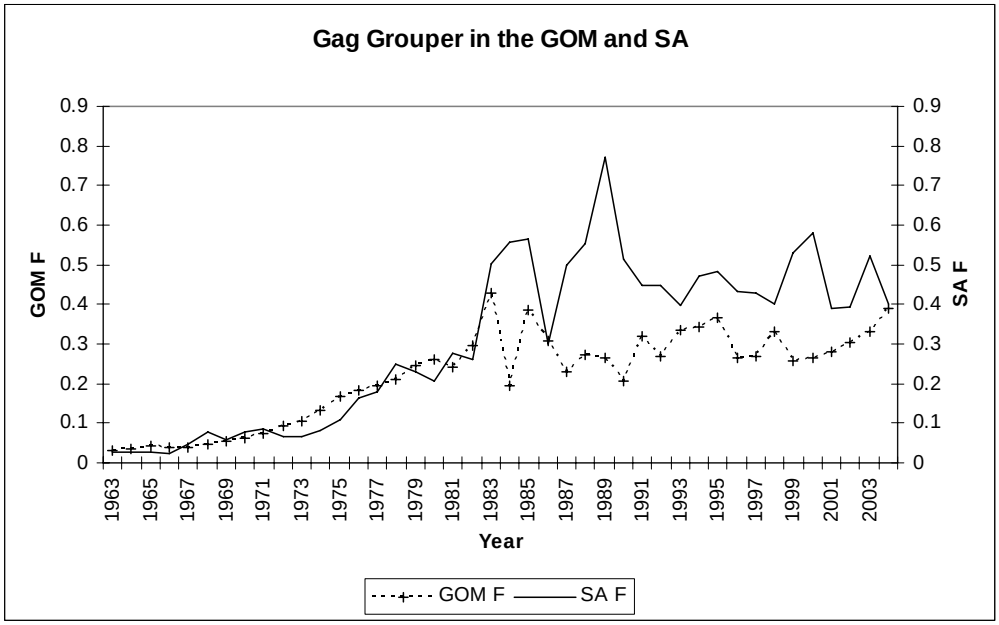
In both stock areas, recruitment has increased in recent years, although the increase is more pronounced in the Gulf of Mexico than in the South Atlantic. Recruitment is estimated to have been about 5 times higher, on average, in the Gulf of Mexico than in the Atlantic.



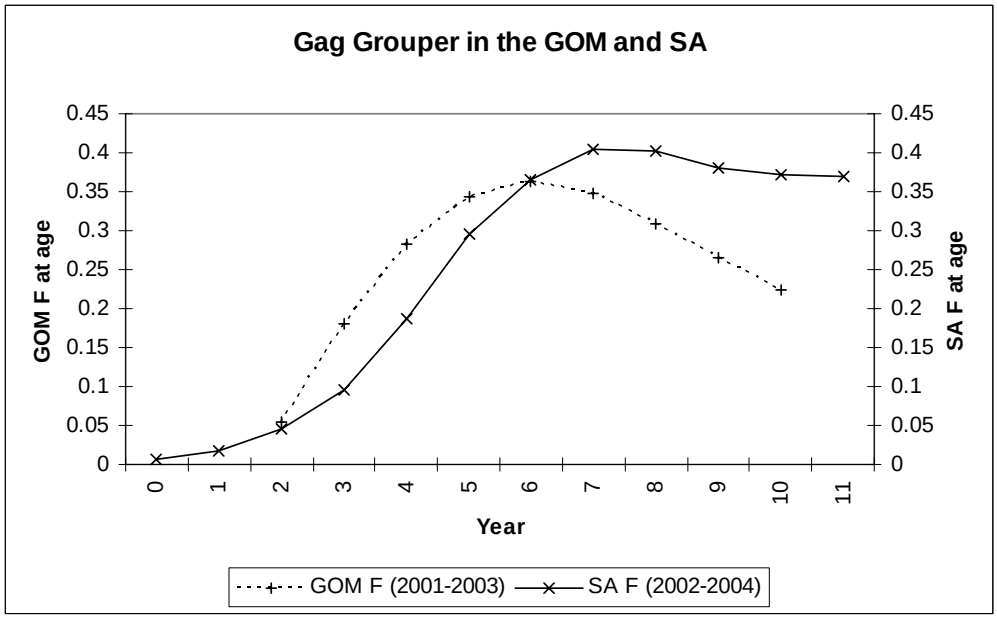
For both stocks, relative SSB's were high in the early 1960s, declined more or less regularly until the early 1990s when both started to increase. The 2004 SSB in the Gulf of Mexico is almost 60% above average, close to the maximum observed in the early 1960s, while for the South Atlantic, the 2004 SSB is 20% above average.



Estimated fishing mortality increased at a very similar rate from the early 1960s to the early 1980s. Since then, both have fluctuated without a clear trend around an average of 0.48 in the South Atlantic and about 0.30 in the Gulf of Mexico.



Average fishing mortality at age (2001-2003 for the GOM, 2002-2004 for the SA) show different patterns. F's are higher at age 3-5 in the Gulf of Mexico than in the South Atlantic but at older ages it is the opposite. The F at age pattern is clearly dome shaped in the Gulf of Mexico and nearly flat topped in the South Atlantic.



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